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Ecological Survey of the Vegetation of the proposed Smoky Creek Research Natural Area, Shasta-Trinity National Forest, Trinity County, California

Report to the R5/PSW Research Natural Area Committee, U.S. Forest Service

D.W. Taylor and K.A. Teare
Botany Department
University of California
Davis, CA 95616

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Abstract

This report details the results of an ecological survey of the vegetation of the proposed Smoky Creek Research Natural Area. The area is being considered for reclassification to Research Natural Area status by the Forest Service, U.S. Department of Agriculture. This report describes the ecological setting of the proposed Research Natural Area in relation to local gradients in vegetation composition.

INTRODUCTION

Location. The proposed Smoky Creek Research Natural Area is located on several minor tributary streams of the South Fork of the Trinity River about 5 miles SE from Forest Glen, Trinity County, California ($40^{\circ}22'N, 125^{\circ}15W$, See Maps 1 & 2). The proposed Research Natural Area boundaries circuitously skirt nearby timbersales at the headwaters of Smoky Creek and Silver Creek in portions of Sections 20, 21, 28, and 29 of T27N,R12W,M.D.M. The area boundaries encompass 250 ha as they are drawn by the Shasta-Trinity National Forest (see Map 3).

Physiography. The Smoky Creek Research Natural Area lies at the head of the easternmost fork of Silver Creek and on the North Fork of Smoky Creek. The area is physiographically a portion of the canyon of the South Fork of the Trinity River, and is near a summit separating the headwaters of the latter stream from those which drain to the Sacramento Valley to the east. Elevations on the proposed Research Natural Area range from about 1000 m (3200 ft) to about 1300 m (4200 ft).

Slopes within the boundaries of the area are generally on the order of 10°-20°, and there are extensive, broad interfluves of lesser slope between Smoky Creek and Silver Creek.

Both Silver Creek and the North Fork of Smoky Creek are ephemeral streams. At the time of our visit (September 1979), they held water only in isolated sections, and are probably completely dry by late-summer in years with less than normal precipitation. The springs in nearby Swim Meadow and at Silver Spring flow throughout the summer months, as do several local unmapped seeps.

The proposed Smoky Creek Research Natural Area is easily accessable via Forest Road 29 (Bramlet Road) off Highway 36 about 7 miles to the east of Forest Glen. The Smoky Creek Trail (12W35) shown on the 1969 Shasta-Trinity National Forest Visitor's Map is signed at its junction with Forest Road 29. This trail is passable by four-wheel drive vehicle into approximately the center of the Research Natural Area. Other trails shown on the Forest Visitor's Map are overgrown and are hard to follow or to detect on aerial photography.

Regional Climate. The nearest recording station in the vicinity of the proposed Research Natural Area is at Forest Glen, 5 miles to the NW and nearly 450 m lower in altitude. The climatic data for Forest Glen are summarized in Table 1. The actual climate of the Smoky Creek area is probably somewhat cooler and wetter than at Forest Glen, owing to higher altitude. The mean annual temperature at Forest Glen is 10.8 $^{\circ}$C (51 $^{\circ}$F), and the mean annual precipitation is 1572 mm. Table 1 also gives

an estimated mean monthly water balance (Major 1977) using the Forest Glen data and assuming 100 mm of soil water storage capacity. Potential Evapotranspiration (PE in Table 1) is estimated to be 664 mm/yr, while Actual Evapotranspiration (AE in Table 1) is estimated at 394 mm/yr. Forest growth is thus probably limited on the most severe topoedaphic sites in this region by water stress. The area probably receives moderate snowfalls in winter.

Geology and Soils. The proposed Smoky Creek Research Natural Area is underlain by Pre-Cretaceous metamorphic rocks, with extensive outcroppings of altered ultrabasic intrusive rock of the same relative age-serpentine. The regional geology has been mapped at a scale of 1:125,000 (Cal. Div. Mines & Geol. 1962), with reconnaissance geology at a scale of 1:24,000 from the South Fork of the Trinity River to the northeast (Hicks 1960).

Soils in the vicinity of Smoky Creek have not been mapped in published form at the series level, nor are soil-vegetation maps available (Colwell 1977). Published soil descriptions for the vicinity of the proposed Research Natural Area are available for Tehama County just to the east (Gowan et al. 1967)

The Sheetiron-Josephine soil assocation described by Gowan et al. develop over hard sedimentary rocks, and are moderately deep, steep or very steep stony soils. The Dubakella-Neuns soils are moderately deep or deep, steep or very steep, stony soils which develop over altered volcanic rocks. Serpentine derived soils of the region are related to this latter complex.

VEGETATION

Regional Vegetation. The proposed Smoky Creek Research Natural Area is located in a region of rapid vegetation transition. Coastward, diverse, mesic coniferous forests are typical, while more inland sites support xeric foothill communities. Sawyer et al. (1977), and Sawyer and Thornburgh (1977) review the diverse vegetation patterns in this general geographic region, but their coverage is based on a limited literature on vegetation composition. The zonal forests of the region are dominated by Pseudotsuga menziesii. Taylor (1975) described the Pseudotsuga forest vegetation across the canyon of the South Fork of the Trinity River from the Smoky Creek area. At this site, on the generally NE facing slopes at the base of South Fork Mountain, Pseudotsuga was the canopy dominant, with minor amounts of Pinus lambertiana, Pinus ponderosa and Abies concolor. Arbutus menziesii, Chrysolepis chrysophylla and Calocedrus decurrens were also present in the tree stratum. The understory of these different associations was open to dense, with xeromesic shrubs such as Berberis nervosa. Taylor (1975) named this assocation the Pseudotsuga menziesii-Berberis nervosa Association.

Serpentine vegetation is also a very important feature of the region. Pinus jeffreyi forms open to semi-dense stands on the more heavily mineralized sites, and a number of rare plant associates occur in these habitats, including Arenaria rosei, Haplopappus ophitidus, Streptanthus barbatus, Asclepias solonana, Eriogonum siskiyouense and Allium hoffmanii (Stebbins 1972).

Survey Methods. We visited the Smoky Creek area on 12-15 September 1979. At that time we sampled 15 plots and 24 releves. Releves were summary lists made in representative habitat types (see Mueller-Dombois and Ellenberg 1974). Each taxon present in a homogeneous area of vegetation was enumerated, and cover of each was visually estimated in the following cover classes: greater than 75%=5; 50-75% cover = 4; 25-50% cover = 3; 5-25% cover = 2; 1-5% cover = 1; less than 1% cover but numerous individuals = +; few individuals of low cover = R. These cover/abundance data form the data entries in Tables 2 and 3.

At selected stands of forest vegetation, 10 m radius circular plots (1 at 15 m radius) were established. Diameter of all stems 1.37 m tall was measured to the nearest .1 cm. A releve was also made at each plot locality.

The releve data was coded and recorded on punch cards for analysis. Association Tables (Tables 2 & 3) were ordered using the algorithm of Ceska and Roemer (1971) as modified by Taylor (1976). Units of vegetation (associations) were determined from this arranged primary data matrix. The stand data were similarly reduced by computer. Appendix 1 gives the summarized data for each plot. Basal Area (m^2/ha), Relative Dominance (Proportion total Basal Area), Density (Stems/ha), Relative Density (Proportion total density), Importance Value (Relative Dominance + Relative Density), and mean stem diameter (cm) were calculated.

Plant Associations. The 39 releves sampled were organized by tabular association analysis (as shown in Tables 2 & 3) to identify groups of similar species with regard to their cooccurrence in the habitats

sampled. From this arranged matrix, 8 associations can be recognized based on the presence/absence of the species groups identified in this analysis. These 8 vegetation types are related in a hierarchical fashion as follows:

A. Alnus rhombifolia-Peltiphyllum peltatum Alliance

1. Alnus rhombifolia-Galium triflorum Association

2. Prunella vulgaris lanceolata-Carex bolanderi Association

B. Deschampsia caespitosa Alliance

3. Deschampsia caespitosa-Carex buxbaumii Association

C. Carex rostrata Alliance

4. Carex exsiccata Association

D. Pinus jeffreyi-Onychium densum Alliance

5. Pinus jeffreyi-Haplopappus ophitidis Association

6. Ceanothus cuneatus-Sitanion hystrix Association

7. Pinus jeffreyi-Calamagrostis koelerioides Association

E. Pseudotsuga menziesii Alliance

8. Pseudotsuga menziesii-Pinus ponderosa Association

A. Alnus rhombifolia-Peltiphyllum peltatum Alliance.

This is the major riparian vegetation type along major watercourses in the mountains of California (Knapp 1965). Along the South Fork of the Trinity River below the Smoky Creek area, this vegetation occurs in its nominate compositional form.

1. Alnus rhombifolia-Galium triflorum Assocation (SAF 221)

This assocation is the ephemeral stream phase of the A. rhombifolia-P. peltatum alliance. The latter characteristic dominant of the herb layer is absent from Smoky Creek at the upper elevations, owing to low summer flows. A typical stand of this assocation has a sparse overstory of

Alnus rhombifolia, with Acer macrophyllum and Pseudotsuga as codominants, averaging 11.0, 1.1 and 3.1 m^2/ha Basal Area respectively. Mesic shrubs are common in the understory, including Rosa pisocarpa, Philadelphus lewisii gordonianus, Rubus parviflorus and Euonymus occidentalis. Galium triflorum is a mesic site herb which dominates the sparse herb layer in this association.

2. Prunella vulgaris lanceolata-Carex bolanderi Association

The vegetation typified by this association is characteristic of seeps and small springs in the Smoky Creek area. Some typical Alnus rhombifolia-Galium triflorum species are present, but this vegetation is a floristically distinct type, with a meadow physiognomy. Carex bolanderi is common, and C. amplifolia is often a codominant along with Torreyochloa pauciflora. Prunella vulgaris lanceolata is a constant species, and also occurs in the previously described association.

C. Deschampsia caespitosa Alliance.

This alliance is an important meadow vegetation unit in the mountains of the Holoarctic (cf. Komarkova 1979). Deschampsia caespitosa is a circumboreal species which dominates these wet, high productivity meadows.

3. Deschampsia caespitosa-Carex buxbaumii Assocation

This vegetation occurs in the Silver Spring and Swim Meadow areas adjacent to the proposed Smoky Creek Research Natural Area. These meadows are supplied by year-round flow of highly mineralized water, and they support a distinctive and uncommon vegetation. The mineralization of these seeps is likely to be unusual due to the close proximity of large

expanses of serpentine nearby. Swim Meadow is dominated by Deschampsia, Juncus covillei and J. effusus. Carex buxbaumii and Helenium bigelovii are conspicuous codominants. Silver Spring appears more heavily mineralized, with the presence of Sisyrinchium idahoense indicating this condition. Rhynchospora glomerata minor is a very rare sedge-like plant which is codominant at Silver Spring. Rhynchospora glomerata var. minor is known fron only 6 other localities in California, and the Silver Spring population represents a new collection. Other distinctive taxa occur in these serpentine seeps, including Cirsium breweri and Hastingsia alba.

C. Carex rostrata Alliance.

This vegetation is characteristic of shallow, often ephemeral pools and ponds in the northern hemisphere mountains. Carex taxa of section Vesicarieae are the indicator group-as they can tolerate the oligotrophic, highly acidic flooded conditions.

4. Carex exsiccata Association

One small pond vegetated by C. exsiccata was seen in the Smoky Creek drainage. Carex exsiccata is the low elevation vicariant of C. vesicarya and C. rostrata, which both dominate wet meadows in much of mountainous California.

E. Pinus jeffreyi-Onychium densum Alliance (SAF 247)

This vegetation is confined to serpentine substrates in the California North Coast Ranges. Whittaker (1960) describes the more northern phase of this vegetation in the Siskiyou Mountains. Serpentine is very common at mid-elevations in the Smoky Creek area, so this vegetation is an important landscape element.

5. Pinus jeffreyi-Haplopappus ophitidis Association

A typical stand of this vegetation is very open, with widely spaced but large Pinus jeffreyi averaging 300 stems/ha and 36 m^2/ha Basal Area. Calocedrus decurrens is a scattered codominant. The shrub understory cover is sparse, with small Ceanothus cuneatus being most common. This association is characteristic of the rawest serpentine sites, and is differentiated by the presence of the low subshrub Haplopappus ophitidis. Calamagrostis koelerioides is a dominant grass in the herb layer.

6. Ceanothus cuneatus-Sitanion hystrix Association.

This association is found on very rocky soils or serpentine outcrops in the Smoky Creek area. Ceanothus cuneatus forms a dense (about 50% cover) low shrub (1 m tall) canopy. Herbs and occasional associated shrub species which form the understory of the Pinus jeffreyi-Haplopappus ophitidis and P. jeffreyi-Calamagrostis koelerioides are present. Soils are poorly developed in these sites, precluding the establishment of P. jeffreyi, although seedlings or stunted small individuals can occasionally be seen here.

7. Pinus jeffreyi-Calamagrostis koelerioides Association

A typical stand of this vegetation is physiognomically similar to the P. jeffreyi-Haplopappus ophitidis association, in that the taxa which differentiate the latter association are small herbs or subshrubs. The overstory characteristics of the two P. jeffreyi vegetation types are similar, with P. jeffreyi averaging 32.8 m^2/ha and 381 stems/ha in this association. This vegetation occurs on serpentine derived soils, but in less heavily mineralized or more highly weathered sites than the P. jeffreyi-H. ophitidis association.

E. Pseudotsuga menziesii Alliance

Pseudotsuga menziesii vegetation is the zonal climatically controlled climax vegetation in the general region of the proposed Smoky Creek Research Natural Area. This vegetation is near to its upper elevational limits in the study area. but is a generally xeric facies of this vegetation at Smoky Creek because of the generally S or W exposures and because of the shallow and partly or totally serpentine derived soils.

8. Pseudotsuga menziesii-Pinus ponderosa Association (SAF 244) This vegetation is the most conspicuous landscape feature of the proposed Smoky Creek Research Natural Area. It grades into the Pinus jeffreyi-Onychium densum alliance very infrequently, and usually only where significant colluviation has occured. Pseudotsuga menziesii-Pinus ponderosa vegetation develops only over non-serpentine substrates in the study area. Following disturbance, Arctostaphylos viscida stands become established on the more xeric sites of this habitat type, and Ceanothus integerrimus stands on the more mesic ecotopes. Neither of these two subassociations were sampled as they are of only local importance on the proposed Research Natural Area.

A typical stand of Pseudotsuga menziesii-Pinus ponderosa vegetation is open to semi-dense. The coniferous overstory is generally older age class individuals of low density. Dense to semi-dense conifer reproduction may occur and is typically patchy. Pseudotsuga is the canopy dominant, averaging 49.6 m^2/ha Basal Area and 498 stems/ha. Pinus lambertiana and Pinus ponderosa share codominance at 14.6 and 18.2 m^2/ha Basal Area respectively, and are both found at about equal densities

of 100 stems/ha. Quercus kelloggii and Q. chrysolepis form a second tree layer. The shrub understory is open, with Toxicodendron diversilobum and an occasional Arctostaphylos viscida or Ceanothus integerrimus. The herb layer is generally sparse, with few constant or dominant species (cf Table 3).

Forest Cover Types. The forest vegetation of the proposed Smoky Creek Research Natural Area typifies the following SAF Forest Cover Types (Soc. American Foresters 1954):

SAF 221 Red Alder (White Alder variant)

SAF 245 Douglas Fir-Ponderosa Pine

SAF 247 Jeffrey Pine

The proposed natural area fully characterizes the spatial and temporal variance of the Douglas Fir-Pacific Ponderosa Pine type in the general vicinity of the headwaters of the South Fork of the Trinity River.

CONCLUSIONS AND RECOMMENDATIONS

Several sensitive plant species occur on the serpentine areas to the east of the proposed Research Natural Area eastern boundary. Map 2 shows some localities of several of these rare plants (data from B. Williams, Shasta-Trinity National Forest). We collected Haplopappus ophitidis on the serpentine in the SW¼ of Section 22, T27N,R12W, but did not observe others of these rare plant taxa given on Map 2. Since our visit was late in the growing season, their presence on the proposed Natural Area can not be ruled out until a full botanical inventory of the region is undertaken.

Rhyncospora glomerata var. minor is a rare sedge-like plant we collected at Silver Spring. It is listed as RARE (R.E.V.D. Code 2-2-2-1, Powell 1974) by the California Native Plant Society. It is only known from six other, widely scattered localities in California.

We also collected Helianthus exilis Gray (R.E.V.D. Code 2-2-?-3) on a vernal seep underlain by serpentine within the proposed Research Natural Area boundaries. Munz (1959) incorrectly followed the treatment of Heiser et. al (1969), and relegated H. exilis to synonomy under H. bolanderi Gray. Heiser (1949) has speculated that H. bolanderi is a very recent derivative taxon which has arisen through introgressive hybridization between H. exilis and the weedy introduced H. annuus L.. Helianthus annuus was introduced to California with the first extensive agriculture, and entered the serpentine belt, according to Heiser's scenario, where H. exilis is native. Our collection of H. exilis some 75 miles north of its previously known range, and the complete lack of H. bolanderi or H. annuus would seem to corroborate Heiser's hypothesis. Heiser's mistake is that H. exilis is the native taxon, and should retain species status, while H. bolanderi is simply a recent hybrid. Thus, a non-introgressed H. exilis population (analagous to a pure strain of any of our Western North American trout not affected by hybridization with introduced strains of rainbow trout) is of critical interest to this impacted and rare species.

The proposed boundaries of the Smoky Creek Research Natural Area are drawn to include the most extensive stands of Pseudotsuga menziesii-Pinus ponderosa vegetation in the drainages of the study area which have

not been disturbed by logging. While this is perfectly valid, it does exclude some very distinct habitats nearby-namely Silver Spring and the heavily serpentinized ridge just to the east of the eastern-most boundary. We recommend the proposed boundaries be adjusted to include these nearby features. It is also our understanding that the Shasta-Trinity National Forest is planning to contract out for a botanical survey in 1980 of the serpentine Pinus jeffreyi areas in the vicinity of the proposed Smoky Creek Research Natural Area. We would recommend that such a survey consider the proper eastern-most boundaries if it is felt that inclusion of additional P. jeffreyi vegetation within the proposed Research Natural Area is warranted.

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Plant species list for the proposed Smoky Creek Research Natural Area, Shasta-Trinity National Forest, Trinity County, California. The number to the right of each taxon is the page number where the taxon can be referenced in Munz and Keck's A California Flora, Munz' Supplement to A California Flora (indicated by S), and Munz's A Flora of Southern California (indicated by FSC).

ACERACEAE

Acer macrophyllum Pursh 996
Riparian. Common.

AMARYLLIDACEAE

Allium sp. 1368
Rocky slopes; serpentine outcrops. Uncommon.
Triteleia laxa Benth. 1381
Rocky slopes. Uncommon.

ANACARDIACEAE

Rhus trilobata Nutt. ex T. & G. var. quinata Jeps. 998
Riparian; ephemeral streambeds. Uncommon.
Toxicodendron diversilobum (T. & G.) Greene 998, 67 FSC
Riparian; mixed conifer forest; rocky talus slopes. Common.

APOCYNACEAE

Apocynum pumilum (Gray) Greene 451
Mixed conifer forest. Frequent.

ARALIACEAE

Aralia californica Wats. 1000
Riparian. Frequent.

ARISTOLOCHIACEAE

Asarum hartwegii Wats. 965
Mixed conifer forest. Infrequent.

ASPIDIACEAE

Polystichum munitum (Kaulf.) Presl. 40
var. imbricans (D.C. Eat.) Maxon
Rocky talus slopes. Frequent.

BETULACEAE

Alnus rhombifolia Nutt. 900
Riparian; seeps. Frequent.
Corylus cornuta Marsh. var. californica (A. DC.) Sharp. 899
Riparian; mixed conifer forest. Common.

BLECHNACEAE

Woodwardia fimbriata Sm. in Rees 44
Seeps in mixed conifer forest. Infrequent.

CAMPANULACEAE

Campanula prenanthoides Durand. 1063
Mixed conifer forest. Infrequent.

CAPRIFOLIACEAE

Lonicera hispidula Dougl. var. vacillans Gray 1051
Seeps. Infrequent.
Symphoricarpos mollis Nutt. in T. & G. 1049
Seeps in mixed conifer forest.

CARYOPHYLLACEAE

Cerastium arvense L. 277
Seep. Infrequent.
Silene californica Durand 288
Mixed conifer forest. Uncommon.

CELASTRACEAE

Euonymus occidentalis Nutt. ex Torr. 967
Riparian. Uncommon.

COMPOSITAE

Achillea lanulosa Nutt. 1228
Serpentine outcrop. Common.
Adenocaulon bicolor Hook 1239
Mixed conifer forest. Common.
Anaphalis margaritacea (L.) Benth. ex Clarke 1263
Common along bars of dry streambeds.
Arnica cordifolia Hook 1243
Mixed conifer forest. Common.
Artemisia douglasiana Bess. in Hook 1237
Serpentine outcrop. Common.
Aster adscendens Lindl. in Hook 1199
Swim Meadow. Infrequent.
Balsamorhiza sagittata (Pursh) Nutt. 1086
Serpentine outcrops. Frequent.

COMPOSITAE

Chrysothamnus parryi (Gray) Greene ssp. latior Hall & Clem. 1189
Serpentine outcrops. Frequent.

Cirsium arvense (L.) Scop. 1280
Seeps. Introduced. Frequent.

Cirsium breweri (Gray) Jeps. 1278
Serpentine outcrops; Swim Meadow. Frequent.

Cirsium callilepis (Greene) Jeps. 1277
Serpentine outcrops. Frequent.

Eriophyllum lanatum (Pursh) Forbes var. lanceolatum (Howell) Jeps. 1146
Serpentine outcrops. Frequent.

Eupatorium occidentale Hook 1268
Riparian. Common.

Haplopappus ophitidis (J.T. Howell) Keck 1179
Serpentine patch on divide between Yolla Bolly and Hayfork ranger districts. Infrequent.

Helenium bigelovii Gray 1139
Swim Meadow; Silver Spring. Frequent.

Helianthus bolanderi Gray 1088
cf. Helianthus exilis Gray
Serpentine seeps. Infrequent.

Hieracium albiflorum Hook 1305
Seeps in mixed conifer forest. Frequent.

Hieracium greenei Gray 1305
Serpentine outcrops. Infrequent.

Lactuca saligna L. 1304
Along meadow border at Swim Meadow. Infrequent.

Lessingia nemaclada Greene 1222
Brushy slopes. Frequent.

Madia elegans D. Don 1115
Ephemeral streambeds. Frequent.

Petasites palmatus (Ait.) Gray 1253
Seeps. Infrequent.

Senecio greenei Gray 1250
Serpentine outcrops. Frequent.

Wyethia angustifolia (DC.) Nutt. 1085
Mixed conifer forest. Uncommon.

CONVOLVULACEAE

Convolvulus sp. 459
Mixed conifer forest. Uncommon.

CORNACEAE

Cornus nuttallii Aud. 1035
Seeps. Common.

Cornus stolonifera Michx. 1034
Riparian. Infrequent.

CRASSULACEAE

Sedum obtusatum Gray ssp. boreale Clausen 727
Rocky talus slopes. Infrequent.

CRUCIFERAE

Erysimum capitatum (Dougl.) Greene 268
Rocky slopes. Infrequent.
Streptanthus barbatus Wats. 218
Serpentine outcrops. Infrequent.
Streptanthus tortuosus Kell. var. pallidus Jeps. 218
Rocky slopes. Infrequent.

CRYPTOGRAMMATACEAE

Onychium densum Brack. in Wilkes 37
Serpentine outcrops. Common.

CUPRESSACEAE

Calocedrus decurrens (Torr.) Florin 59, 7S
Mixed conifer forest, serpentine outcrops. Common.

CUSCUTACEAE

Cuscuta subinclusa Dur. & Hilg. 467
Infrequent.

CYPERACEAE

Carex amplifolia Boott. 1456
Seeps. Common.
Carex bolanderi Olney 1443
Seeps. Common.
Carex buxbaumii Wahl. 1458
Swim Meadow. Common.
Carex exsiccata Bailey 1462
Swim Meadow; seeps and vernal pool. Infrequent.
Carex globosa Boott. 1450
Mixed conifer forest, serpentine outcrops. Infrequent.
Carex multicaulis Bailey 1451
Riparian. Frequent.
Carex nudata W. Boott. 1460
Riparian. Frequent.
Heleocharis montevidensis Kunth. 1420
var. parishii (Britton) V. Grant
Uncommon in Swim Meadow.
Rhynchospora glomerata (L.) Vahl. var. minor Britton 1428
Silver Spring. Infrequent.

DATISCACEAE

Datisca glomerata (Presl.) Baill. 177
Riparian; seeps. Infrequent.

DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn var. pubescens Underw. 32
Seeps. Frequent.

EQUISETACEAE

Equisetum arvense L. 28
Silver Spring; seeps. Common.
Equisetum laevigatum A. Br. 27
Seeps. Common.
Equisetum telmateia Ehrh. var. braunii Milde 27
Seeps. Infrequent.

ERICACEAE

Arbutus menziesii Pursh. 415
Mixed conifer forest. Infrequent.
Arctostaphylos manzanita Parry 422
Serpentine outcrops. Frequent.
Arctostaphylos viscida Parry 424
Mixed conifer forest. Frequent.

FAGACEAE

Chrysolepis chrysophylla (Dougl. ex Hook) Hjelmquist 901, 1205
Seeps. Infrequent.
Quercus chrysolepis Liebm. 906
Mixed conifer forest. Common.
Quercus durata Jeps. 906
Serpentine outcrops. Frequent.
Quercus garryana Dougl. 904
Mixed conifer forest; serpentine outcrops. Frequent.
Quercus kelloggii Newb. 903
Mixed conifer forest. Common.

GRAMINEAE

Agrostis exarta Trin. 1522
Vernal pond. Frequent.
Bromus marginatus Nees. 1470
Riparian; seeps; serpentine outcrops. Common.
Bromus tectorum L. 1474
Grassy meadows; brushy slopes. Frequent.
Calamagrostis koelerioides Vasey 1518
Serpentine outcrops. Common.
Deschampsia caespitosa (L.) Beauv. 1513
Swim Meadow; Silver Spring. Common.

GRAMINEAE

Elymus glaucus Buckl. 1505
Riparian; seeps. Common.

Melica californica Scribn. 1498
Mixed conifer forest. Infrequent.

Sitanion hystrix (Nutt.) J. G. Sm. 1506
Serpentine outcrops. Common.

Torreyochloa pauciflora (Presl.) Church 1480
Seeps in mixed conifer forest. Common.

Vulpia sp. 1475
Serpentine outcrops. Frequent.

HYDROPHYLLACEAE

Phacelia corymbosa Heps. 534
Serpentine outcrops. Frequent.

IRIDACEAE

Iris tenuissima Dykes 1390
Serpentine outcrops. Frequent.

Sisyrinchium idahoense Bickn. 1393
Silver Spring. Frequent.

JUNCACEAE

Juncus covillei Piper 1407
Swim Meadow; seeps. Frequent.

Juncus effusus L. var. gracilis Hook. 1404
Swim Meadow; Silver Spring. Frequent.

Juncus ensifolius Wikstr. 1412
Seeps. Frequent.

LABIATAE

Monardella odoratissima Benth. ssp. pallida (Heller) Epl. 713
Serpentine outcrops; ephemeral streambeds. Frequent.

Prunella vulgaris L. ssp. lanceolata (Barton) Hult. 697
Riparian; seeps. Common.

Pycanthemum californicum Torr. 716
Ephemeral streambeds. Frequent.

Scutellaria antirrhinoides Benth. 695
Ephemeral streambeds; seeps. Common.

Stachys mexicana Benth. 698, 1025
Riparian. Common.

LEGUMINOSAE

Cercis occidentalis Torr. ex Gray 799
Serpentine outcrops. Frequent.
Lathrys polyphyllus Nutt. ex T. & G. 91
Coniferous forests, Frequent.
Lotus grandiflorus Benth.) Green 845
Silver Spring.
Lotus purshianus (Benth.) Clem. & Clem. 847
Mixed conifer forest. Frequent.
Lupinus latifolius J.G. Agardh 832
Mixed conifer forest. Infrequent.
Lupinus stiversii Kell. 812
Banks along Smoky Creek, Uncommon.
Trifolium monathum Gray 839
Meadows. Infrequent
Trifolium sp.
Along dry streambeds. Uncommon.

LILIACEAE

Disporum hookeri (Torr.) Nichols 1332
var. trachyandrum (Torr.) Q. Jones
Mixed conifer forest. Frequent.
Hastingsia alba (Durand) S. Watson 1329
Swim Meadow; Silver Springs. Common.
Lilium pardalinum Kell. 1342
Seeps. Frequent.
Smilacina racemosa (L.) Desf. 1331
Rocky talus slopes. Common.

MALVACEAE

Sidalcea glaucescens Greene 134
Swim Meadow. Uncommon.

ONAGRACEAE

Epilobium adenocaulon Hausskn. var. parishii (Trel.) Munz 932
Swim Meadow. Frequent.
Epilobium paniculatum Nutt. ex T. & G. 929
Swim Meadow. Frequent.

ORCHIDACEAE

Epipactis gigantea Dougl. ex Hook. 1399
Silver Spring. Frequent.
Habenaria dilata (Pursh) Hook. 1396
var. leucostachys (Lindl.) Ames
Silver Spring. Frequent.

PINACEAE

Abies concolor (Gord. & Glend.) Lindl. 49
Mixed conifer forest; seeps. Infrequent.
Pinus jeffreyi Grev. & Balf. in A. Murr. 54
Serpentine outcrops. Common.
Pinus lambertiana Dougl. 52
Mixed conifer forest; rocky slopes. Common.
Pinus ponderosa Dougl. ex P. & C. Lawson 53
Mixed conifer forest. Common.
Pinus sabiniana Dougl. 55
Serpentine outcrops. Infrequent.
Pseudotsuga menziesii (Mirb.) Franco 57
Mixed conifer forest; serpentine outcrops. Common.

POLYGALACEAE

Polygala cornuta Kell. 156
Mixed conifer forest. Infrequent.

POLYGONACEAE

Eriogonum compositum Dougl. ex Benth. 45S
Serpentine outcrops. Infrequent.
Eriogonum nudum Dougl. ex Benth. var. oblongifolium Wats. 68S
Serpentine outcrops. Frequent.
Eriogonum strictum Benth. 65S
ssp. proliferum (T. & G.) S. Stokes
Serpentine outcrops. Frequent.
Eriogonum sp. 33S
Serpentine outcrops. Infrequent.
Polygonum spergulariaeforme Meissn. 362
Rocky slopes. Frequent.
Polygonum sp. 360
Rocky slopes. Frequent.
Rumex californicus Rech. 357
Seeps and vernal pond. Frequent.

PRIMULACEAE

Dodecatheon sp. 400
Grassy, rocky slopes.
Trientalis latifolia Hook. 404
Mixed conifer forest. Common.

PYROLACEAE

Chimaphila menziesii (R. Br. ex D. Don) Spreng. 435
Mixed conifer forest. Infrequent.
Chimaphila umbellata (L.) Barton 435
var. occidentalis (Rydb.) Blake
Mixed conifer forest. Frequent.

PYROLACEAE

Pyrola picta Sm. 434
Mixed conifer forest. Infrequent.
Pyrola picta Sm. forma aphylla (Sm.) Camp. 434
Mixed conifer forest. Rare.

RANUNCULACEAE

Aquilegia formosa Fisch. in DC. 105
var. truncata (F. & M.) Baker
Riparian; seeps in mixed conifer forest. Common.
Clematis ligusticifolia Nutt. in T. & G. 103
Seeps. Infrequent.
Delphinium sp. 81
Riparian. Infrequent.

RHAMNACEAE

Ceanothus cuneatus (Hook) Nutt. 982
Rocky, serpentine slopes. Common.
Ceanothus integerrimus H. & A. 977
Rocky slopes. Common.
Ceanothus prostratus Benth. 984
Mixed conifer forest. Infrequent.
Rhamnus californica Esch. 972
Serpentine outcrops Frequent.
Rhamnus purshiana DC. 973
Riparian; seeps. Frequent.

ROSACEAE

Amelanchier pallida Greene 793
Riparian. Frequent.
Cercocarpus betuloides Nutt. ex T. & G. 782
Rocky, serpentine outcrops. Infrequent.
Potentilla glandulosa Lindl. 774
Ephemeral streambeds. Infrequent.
Rosa pisocarpa Gray 787
Riparian, seeps. Common.
Rubus parviflorus Nutt. 785
Riparian; seeps. Common.
Rubus ursinus Cham. & Schlecht. 784
Riparian; seeps. Common.

RUBIACEAE

Galium ambiguum Wight var. siskiyouense Ferris 1041
Serpentine outcrops. Frequent.
Galium nuttallii Gray 1042
Serpentine outcrops. Frequent.
Galium triflorum Michx. 1040
Riparian; seep. Common.

SALICACEAE

Salix laevigata Bebb. 913
Riparian. Frequent.

SAXIFRAGACEAE

Heuchera micrantha Dougl. ex Lindl. 741
Rocky slopes. Uncommon.
Parnassia palustris L. var. californica Gray 731
Silver Spring. Frequent.
Philadelphus lewisii Pursh ssp. californicus (Benth.) Munz 744
Riparian. Frequent.
Whipplea modesta Torr. 745
Mixed conifer forest; seeps. Infrequent.

SCROPHULARIACEAE

Mimulus guttatus Fisch. ex DC. 616
Swim Meadow; Silver Spring. Frequent.
Mimulus moschatus Dougl. ex Lindl. 610
Seeps. Common.
Penstemon corymbosus Benth. 641
Rocky slopes. Uncommon.
Veronica americana (Raf.) Schw. 656
Seeps. Frequent.

SINOPTERIDACEAE

Cheilanthes gracillima D.C. Eat. in Torr. 34
Rocky slopes. Frequent.
Pellaea brachyptera (T. Moore) Baker 36
Serpentine outcrops. Frequent.

TAXACEAE

Taxus brevifolia Nutt. 65
Riparian; seeps. Uncommon.

UMBELLIFERAE

Ligusticum sp. 1013
Riparian. Frequent.
Lomatium sp. 1018
Rocky slopes. Frequent.
Perideridia gairdneri (H. & A.) Math. 1013
Swim Meadow. Infrequent.

VERBENACEAE

Verbena hastata L. 687
Riparian. Infrequent.

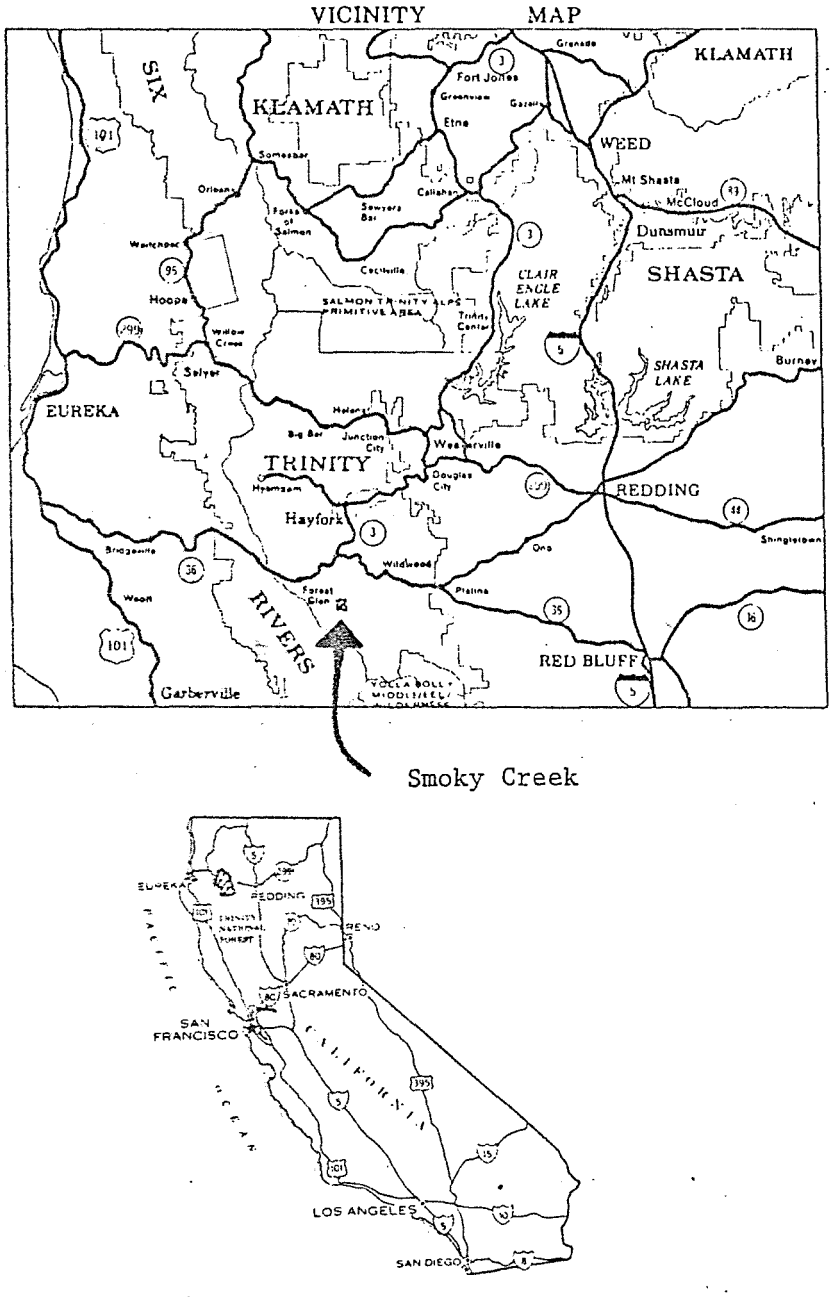
VITACEAE

Vitis californica Benth. 969
Riparian. Infrequent.

Voucher specimens collected on the proposed Smoky Creek Research Natural Area and vicinity. The collection numbers given ar those of Dean Wm. Taylor. Specimens are deposited in the Herbarium, University of California, Davis. Those indicated by HSU are duplicates sent to Humboldt State University, Arcata.

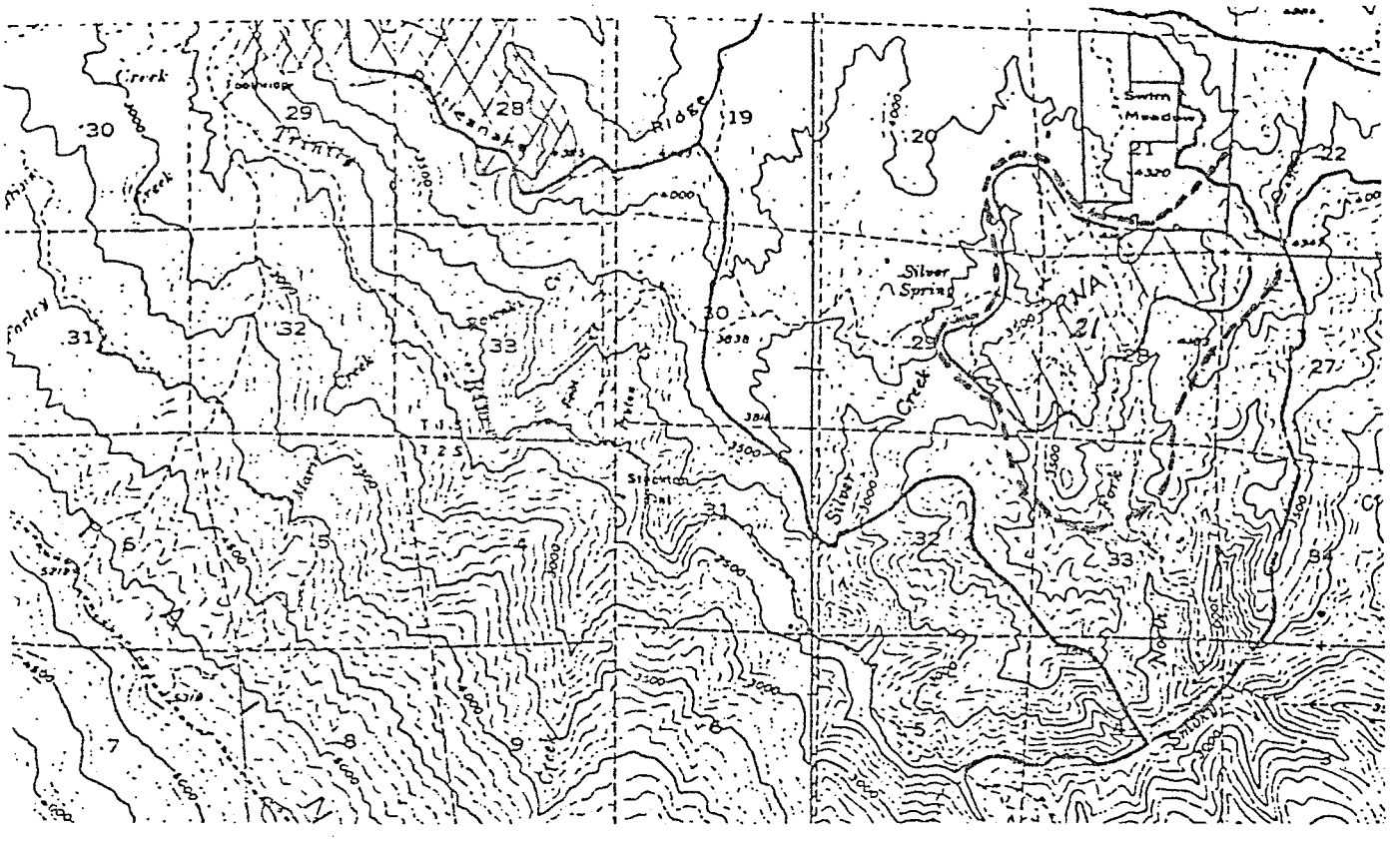
7696A Galium triflorum Michx.
7696B Juncus effusus L. var. gracilis Hook.
7697 Datisca glomerata (Presl.)Baill.
7698 Juncus covillei Piper HSU
7699 Agrostis exarta Trin.
7700 Carex exsiccata Bailey
7701 Monardella odoratissima Benth.
7703 Haplopappus ophitidis (J. T. Howell) Keck
7704 Wyethia angustifolia (DC.)Nutt.
7705 Helianthus exilis Gray HSU
7706 Pycanthemum californicum Torr. HSU
7707 Scutellaria antirrhinoides Benth.
7708 Cuscuta subinclusa Dur. & Hilg.
7709 Polygonum spergulariaeforme Meissn. HSU
7710 Perideridia gairdneri (H. & A.) Math.
7711 Chrysothamnus parryi (Gray)Greene ssp. latior Hall & Clem.
7714 Lactuca saligna L.
7715 Hastingsia alba (Durand) S. Wats.
7716 Juncus ensifolius Wikstr.
7717 Cirsium breweri (Gray) Jeps. HSU
7718 Helenium bigelovii Gray
7719 Sidalcea glaucescens Greene
7720 Aster adscendens Lindl.
7721 Parnassia palustris L. var. californica Gray
7722 Epipactis gigantea Dougl. ex Hook.
7723 Rhynchospora glomerata (L.)Vahl. var. minor Britton. HSU
7723 Carex buxbaumii Wahl.
7725 Lotus purshianus (Benth.) Clem. & Clem.

Map 1. Regional map showing the general location of the proposed Smoky Creek Research Natural Area.

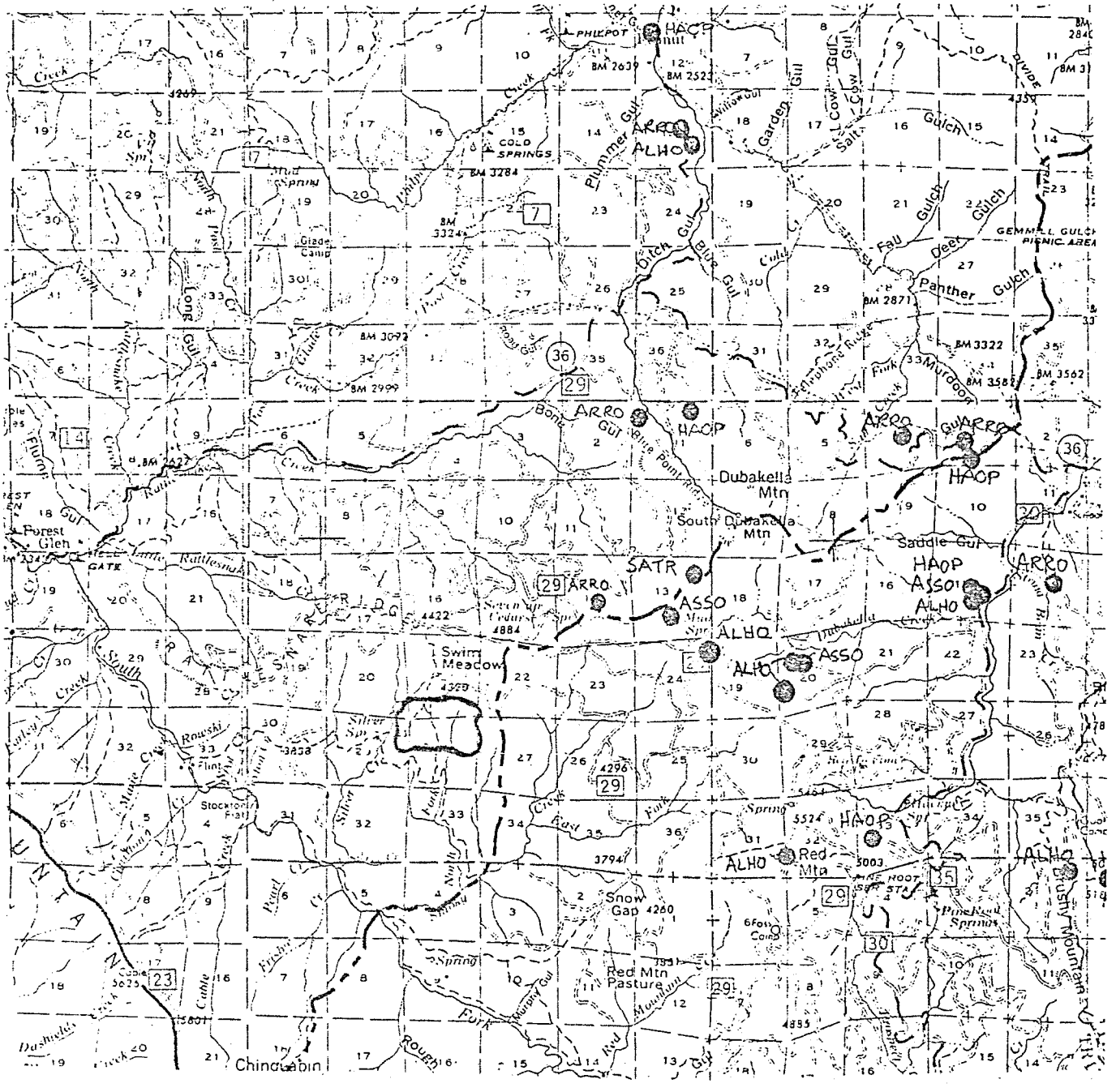


Map 3.

Topographic map showing the location of the proposed Smoky Creek Research Natural Area. The solid line shows the boundaries as porposed by the Shasta-Trinity National Forest. Our proposed boundaries are shown by the dotted line. The upper boundary could be left at Forest Road 29 if it is felt that inclusion of additional Pinus jeffreyi Habitat types is not needed. (Dubakella 15' map)



Map 2. Map showing the location of the proposed Smoky Creek Research Natural Area.
(The dots plot the location of several rare plant taxa in the vicinity. See text for details. The taxa are coded by 2 letter abreviations of the generic name and the specific epithet). ALHO: Allium hoffmanii; HAOP: Haplopappus ophitidis; ARRO: Arenaria rosei; SATR: Sanicula tracyi; ASSO: Asclepias solanoana.



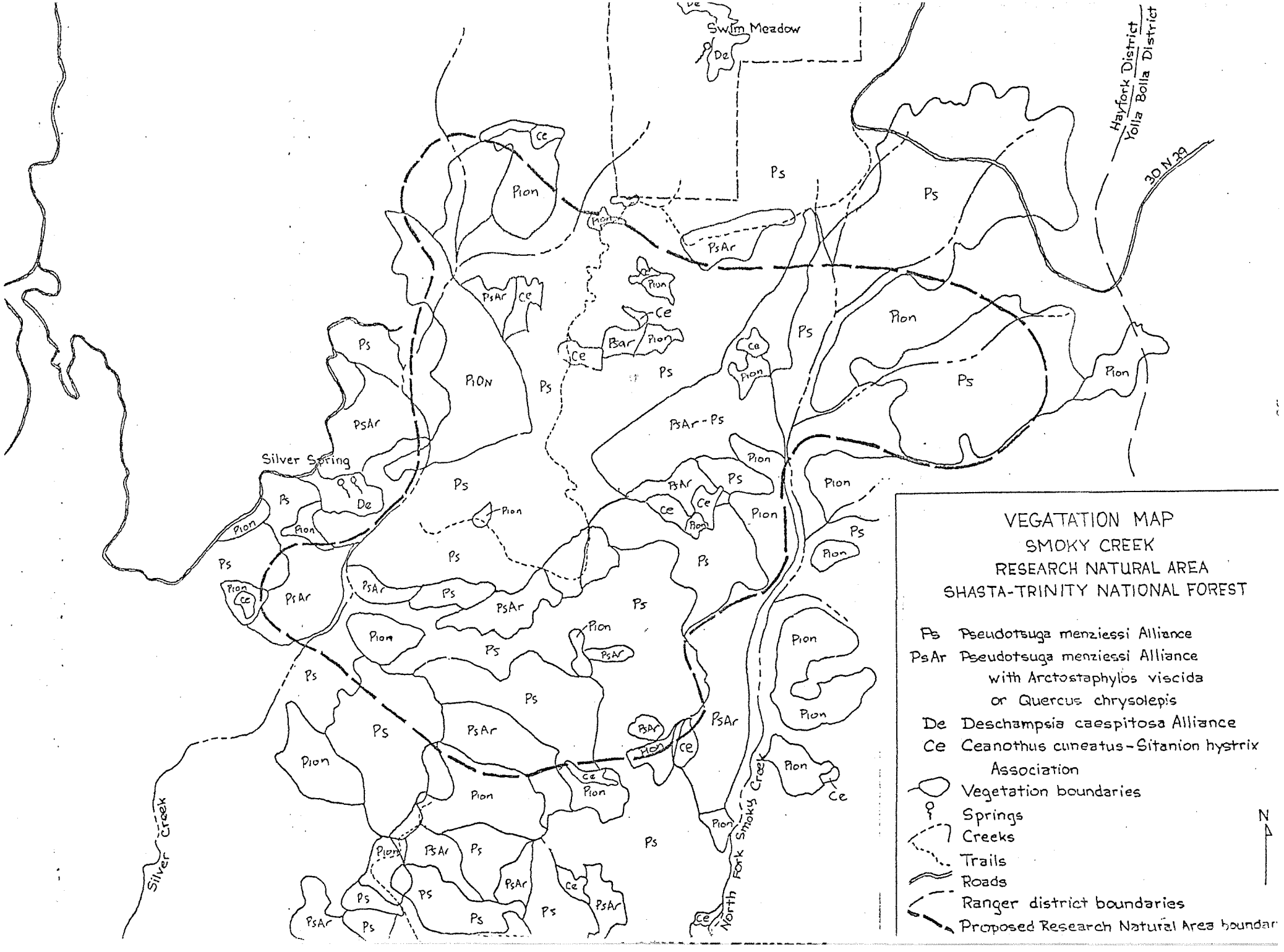

Swim Meadow
De
Hayfork District
Yolla Bolla District
30N29
Ce
Pion
Ps
PsAr
Bar
PION
PsAr-Ps
Silver Spring
De
Silver Creek
North Fork Smoky Creek
VEGATATION MAP
SMOKY CREEK
RESEARCH NATURAL AREA
SHASTA-TRINITY NATIONAL FOREST
Ps Pseudotsuga menziessi Alliance
PsAr Pseudotsuga menziessi Alliance with Arctostaphylos viscida or Quercus chrysolepis
De Deschampsia caespitosa Alliance
Ce Ceanothus cuneatus-Sitanion hystrix Association
Vegetation boundaries
Springs
Creeks
Trails
Roads
Ranger district boundaries
Proposed Research Natural Area boundar
N

Table 1. Climatic summary for the Forest Glen station nearby the proposed Smoky Creek Research Natural Area.

LOC: Forest Glen Ranger Station, Trinity County, California. 2343 feet elevation.
Means taken from 1973 California Annual Summary.
LAT: 40.22 N
MAX SS: 100 mm

	J	F	M	A	M	J	J	A	S	O	N	D	YR
T	1.9	4.2	6.6	9.8	14.8	16.3	20.2	19.9	16.6	11.3	5.7	2.8	10.8
PE	5	12	26	46	85	96	126	115	81	47	18	7	664
P	304	243	196	97	114	23	7	3	20	103	168	296	1572
SS	100	100	100	100	100	48	14	4	2	58	100	100	
AE	5	12	26	46	85	75	40	13	22	47	18	7	394
-						21	86	103	60				269
+	299	231	170	51	29					0	108	289	1177

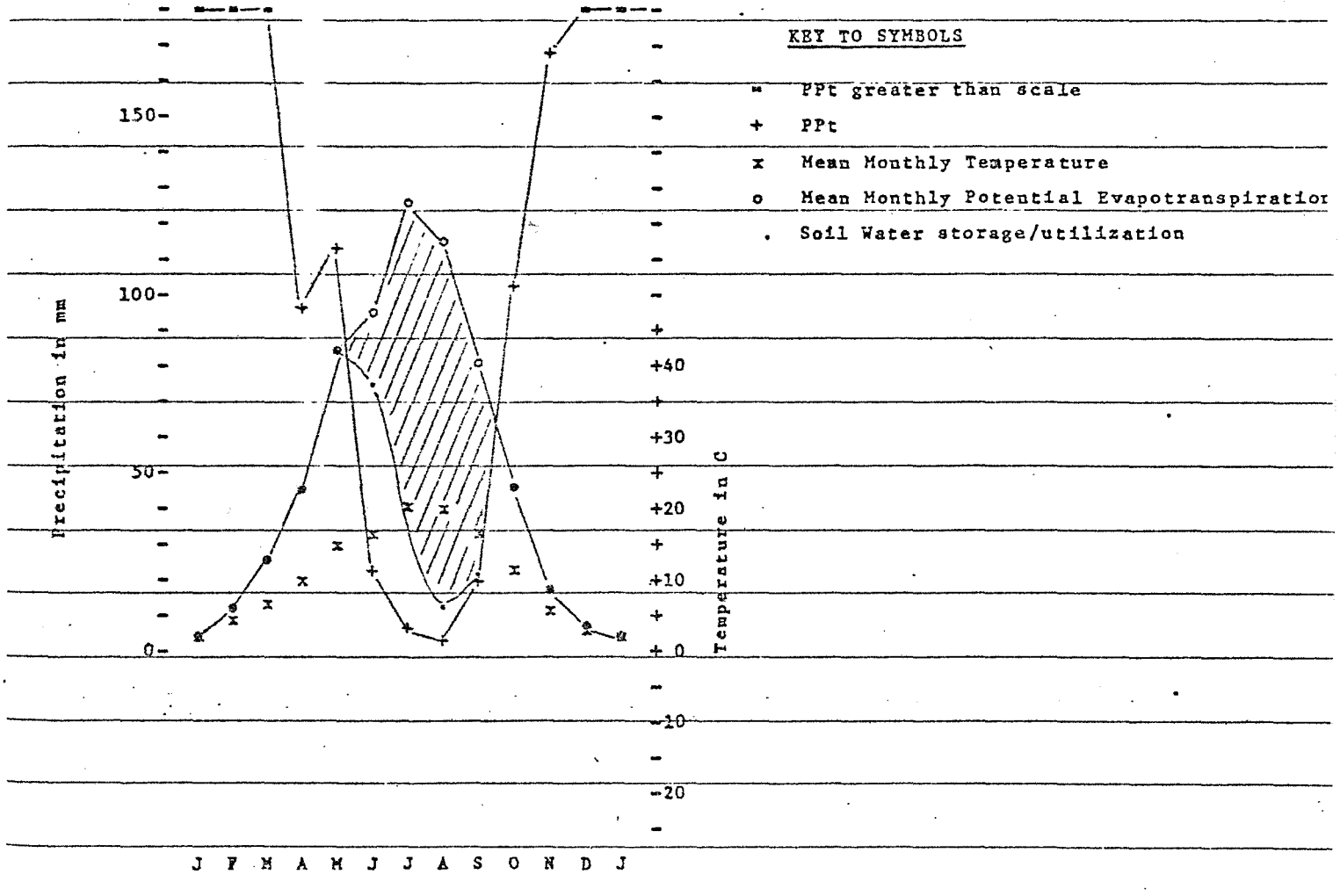


Table 2

ALLIANCE	Alnus rhombifolia-Peltiphyllum peltatum									D. caespitosa			Carex rostrata	
ASSOCIATION	Alnus rhombifolia-Galium triflorum							Prunella vulgaris-Carex bolanderi		Deschampsia caespitosa-Carex bauxbaumii			Carex exsiccata	
Plot or Releve Code	SMK 2 3	SMK 2 4	SMK P 3	SMK 4	SMK 6	SMK P 1	SMK 7	SMK 2	SMK 1 5	SMK 1 4	SMK 1 7	SMK 1 8	SMK 1 9	SMK 1
ELEVATION(m)	1219	1127	994	1355	1274	1222	990	1359	1143	1219	1271	1030	1029	1027
SLOPE	0°	1°	2°	2°	2°	2°	2°	0°	1°	6°	3°	10°	12°	15°
ASPECT	SE	N	SSE	NE	N	ESE	NE	WNW	W	N	SW	SE	SSE	SE
SUBSTRATE	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCub	PCub	PCub	PCub
ALNUS RHOMBIFOLIA	2	1	3	1	2	4	1							
ACER MACROPHYLLUM	2	+	1	1			1							
ELYMUS GLAUCUS	+		+	1	2	1	1	+	+					
ROSA PISOCARPA		+				+	+	+						
GALIUM TRIFLORUM	1	1		1	1	1	1		2					
CAREX NUDATA	+	+	2	2	2									
ARALIA CALIFORNICA	1	+	2		+		1							
PTERIDIUM AQUILINUM PUBESCENS	1					+	1							
STACHYS MEXICANA		+				2	1		2					
AQUILEGIA FORMOSA TRUNCATA		+	+	1		1	+							
OATISCA GLOMERATA				1	+	1	+			1				
CHRYSOLEPSIS CHRYSOPHYLLA	1	+				2								
PHILADELPHIS LEWISII GORDONIANUS			1		+		+							
SCUTILLARIA ANTHIRRNOIDES	+			2	2									
CAREX BOLANDERI						1	+	1	1					
TORREYOCHLOA PAUCIFLORA			+			3			2					
CAREX AMPLIFOLIA						1	1		2					
RUBUS LEUCODERMIS						2	+	+						
EQUISETUM LAEVIGATUM						1	1		2					
VERONICA AMERICANA						+			1					
CIRSIUM ARVENSE						1		+	+					
PRUNELLA VULGARIS LANCEOLATA				1	+	1	1	3	1	1	1	1	+	
DESCHAMPSIA CAESPITOSA										3	2	?	2	
JUNCUS COVILLEI						+		1		1	1	?	2	+
JUNCUS EFFUSUS GRACILIS						3			+	1	3	1	1	
CAREX BAUXBAUMII										1	3	?	2	
CIRSIUM BREWERI										+	+	+	1	
HASTINGSIA ALBA				2						+	1	+	1	
HELENIUM BIGELOVII									+	1	1	+	+	
MIMULUS GUTTATUS										1	+	+	+	
EQUISETUM ARVENSE									+		1	+	+	
EPILOBIUM ADENOCAULON						+				+			+	
PARNASSIA PALUSTRUS CALIFORNICA											+	?	2	
JUNCUS ENSIFOLIUS									+		1	+	1	
RHYNCHOSPORA GLOMERATA MINOR											1	+	R	
EPIPACTIS GIGANTEA											1	1	+	
SISYRINCHIUM IDAHOENSE											1	1	+	
HABENARIA DILATATA LEUCOSTACHYS											+	1		
CAREX EXSICCATA														5
RUMEX CALIFORNICUS								1		+				+
MIMULUS MOSCHATUS								1						
VITIS CALIFORNICA			1											
PERIDERIDA GARDNERI										+				
SIDALCEA GLAUCESCENS										+				
HELEOCHARIS PARISHII										1				
ASTER ADSCENDENS										1				
POTENTILLA GLANDULOSA NEVADENSIS					+									
PYCANTHEMUM CALIFORNICUM					1								+	
ARTEMISIA DOUGLASII				1	1									
AGROSTIS EXARATA														+
TRIFOLIUM MONANTHUM								+						
LILIUM PARDALINUM		+							+					
MUHLENBERGIA FILIFORMIS														
PETESITES PALMATA							2							
LOTUS GRANDIFLORUS			+						1				1	
ABIES CONCOLOR						+								
AMELANCHIER PALLIDA				+										
EUONYMUS OCCIDENTALIS							+							
EUPATORIUM OCCIDENTALE			+		+									

Table 3

ALLIANCE	Pinus jeffrevi-Orvchium densum													Pseudotsuga menziesii										
ASSOCIATION	Pinus jeffrevi Ceanothus Haplopappus ophitidis				cuneatus- Sitanion hystrix		Pinus jeffrevi- Calamagrostis koelerioides							Pseudotsuga menziesii-Pinus ponderosa										
Plot or Releve Code	SMK P 80	SMK P 20	SMK P 70	SMK F 10	SMK 21	SMK 5	SMK 10	SMK 13	SMK P 13	SMK 16	SMK 66	SMK 75	SMK P9	SMK P 2	SMK P 4	SMK P 5	SMK P 12	SMK P 11	SMK P 7	SMK P 26	SMK P 11	SMK P 15	SMK P	SMK P 12
ELEVATION(m)	1316	1310	1075	1219	1188	1335	1036	1347	1127	1249	1066	1222	1229	1188	1182	1176	1143	1097	1013	1182	1173	1097	960	1011
SLOPE	10°	10°	10°	12°	15°	10°	20°	16°	15°	10°	20°	15°	5°	25°	21°	4°	5°	10°	15°	15°	20°	25°	45°	19°
EXPOSURE	SSW	SW	NE	W	SW	ENE	SSE	SSW	SW	N	E	SW	WNW	NNE	WNW	WNW	SE	NE	NNW	SE	SE	NW	S	NNW
SUBSTRATE	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCub	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCm	PCub
PINUS JEFFREYI	3	3	3	+			3	2	3	3	3	1	3											
CEANOTHUS CUNEATUS	2	1	+	4	3	4	2	2	+	+	1	+												
CALAMAGROSTIS KOELERIOIDES	+	+	+	+		+		+	+	+	+	+	1											
SITANION HYSTRIX		1	+	1	+	2	1	+			1													
ONYCHIUM DENSUM	+	+	+	+		+	1	+	+	+	+	+												
RHAMNUS CALIFORNICA TOMENTELLA	+		R		2	+	1		+	R		1	+											
ERIOGONUM NUDUM OBLONGIFOLIUM	+	+		+				+			+	+												
QUERCUS DURATA		+	2							2	2													
POLYGONUM SPERGULARIAEFOLIUM			+		+	+				+		+												
CERCOCARPUS BETULOIDES					+	+		+																
HAPLOPAPPUS OPHETIDUS	1		+																					
PHACELIA CORYMBOSA	+	1	+																					
ERIOPHYLLUM LANATUM LANCEOLATUM	+	+	+					+																
ERIOGONUM STRICTUM	+	+																						
CIRSIUM CALLIPES	+		+			+																		
SENECIO GREENEI	+																							
QUERCUS KELLOGII															2	?	1	+		?	1	1		
CORYLUS CORNUTA CALIFORNICA														2	2			+	+					
HERACLEUM ALBIFLORUM														+	+	+	+		+					
CHIMAPHILA UMBELLATA OCCIDENTALIS													R	+	+	+	+					+		
BROMUS MARGINATUS															1	1	+	+	1	+				?
LATHYRUS POLYPHYLLUS														+	1	+			2					
PYROLA PICTA														+	+			+	+					
APOCYNUM PUMILUM														1	+	+								
PSEUDOTSUGA MENZIESII				+									P	2	5	+	3	4	4	3	3	1	2	?	2	1
PINUS PONDEROSA														+	+	?	4	1	1		+	1	1		?	1
QUERCUS CHRYSOLEPIS										+	+		1	+	4	3	2	+	+	2	1	+	1	3		?
PINUS LAMBERTIANA									R						1	3	1	1		?	1	3	3	1		+
TOXICODENDRON DIVERSILOBUM											+	+	+	•	1	+	+	+			+			1		
CALOCEDRUS DECURRENS			1	+				+	1	1	2	+	2			?				R	+				3	
ARCTOSTAPHYLOS VISCIDA							+														+	3	2			3
ACHILLEA LANULOSA				+				+																		
CAREX GLOBOSA							+																			
HELIANTHUS EXILIS						+																				
HETEOTHECA ANGUSTIFOLIA						+																				
BALSAMORHIZA SAGITTATA											+	+									+				+	
GALIUM AMBIGUM SISKIYOUENSE				+								+								+						
PINUS SABINIANA								1																		
CERCIS OCCIDENTALIS				1				2																		
BROMUS TECTORUM																										
MADIA ELEGANS																										
CHRYSOTHAMNUS PARRYI LATIOR							1		R																	
STREPTANTHUS TORTUOSUS PALLIDUS																										
ZAUSCHNERIA CALIFORNICA LATIFOLIA																										
MUHLENBERGIA ODORATISSIMA PALLIDA								1				+														
SYMPHORICARPOS MOLLIS															1		+									
CORNUS NUTTALLII																		+								
ARBUTUS MENZIESII																			1							
CAREX MULTICAULIS																									1	
IRIS TENUISSIMA								+				+					+		+						1	
PHYSOCARPUS FLAVESCENS VILLOSUS																										

Table 4.

Summary of forest plot data for the Smoky Creek area. Upper values are means for all plots of a given type, and lower values are Coefficient of Variation expressed as a percentage of the mean value.

Taxon	Basal Area (m^2/ha)	Rel. Dom.	Density (Stems/ha)	Rel. Dom.	Impt. Value	$\bar{X}$ DBH (cm)
A. Alnus rhombifolia-Galium triflorum Association. Plots 1,3.						
Alnus rhombifolia	11.0	58.0	111.3	52.5	110.5	34.3
	(12)	(63)	(20)	(74)	(68)	(01)
Abies concolor	7.3	23.1	94.5	25.0	48.2	12.0
	(141)	(141)	(141)	(141)	(141)	(141)
Acer macrophyllum	1.1	7.8	15.9	10.0	17.8	15.0
	(141)	(141)	(141)	(141)	(141)	(141)
Pseudotsuga menziesii	3.1	9.9	15.9	4.1	14.0	25.0
	(141)	(141)	(141)	(141)	(141)	(141)
Taxus brevifolia	0.2	0.8	15.9	4.1	5.0	7.5
	(141)	(141)	(141)	(141)	(141)	(141)
Chrysolepis chrysophylla	0.1	0.1	15.9	4.1	4.1	2.0
	(141)	(141)	(141)	(141)	(141)	(141)
B. Pinus jeffreyi-Haplopappus ophitidis Association. Plots 7,8.						
Pinus jeffreyi	36.2	87.5	302.7	65.0	152.8	35.7
	(64)	(15)	(37)	(10)	(13)	(73)
Calocedrus decurrens	3.4	12.0	175.0	35.0	47.1	14.7
	(76)	(107)	(64)	(20)	(42)	(63)
C. Pinus jeffreyi-Calamagrostis koelerioides Assocation. Plots 4,9,13.						
Pinus jeffreyi	32.8	65.3	381.9	67.6	132.2	39.3
	(32)	(45)	(88)	(53)	(46)	(57)
Calocedrus decurrens	24.1	43.8	180.4	16.2	45.2	25.8
	(98)	(29)	(90)	(87)	(88)	(94)
Pseudotsuga menziesii	3.7	5.1	190.9	9.8	21.1	8.2
	(170)	(170)	(159)	(146)	(159)	(11)

Table 4 concluded.

Taxon	BA	RD	D	RD	IV	$\bar{X}$
D. Pseudotsuga menziesii-Pinus ponderosa Assocation. Plots 2,5,6,11,12,14,15.						
Pseudotsuga menziesii	49.6 (61)	53.7 (57)	498.2 (63)	48.7 (43)	102.1 (45)	24.4 (36)
Pinus lambertiana	14.6 (125)	21.7 (139)	104.0 (80)	11.7 (86)	33.6 (117)	27.0 (92)
Pinus ponderosa	18.4 (186)	19.1 (121)	95.0 (131)	11.3 (133)	30.5 (113)	37.0 (91)
Quercus chrysolepis	2.2 (181)	2.4 (168)	157.5 (82)	16.0 (84)	17.9 (84)	8.6 (65)
Quercus kelloggii	1.1 (134)	1.7 (143)	62.6 (87)	7.3 (90)	9.0 (100)	8.7 (83)
Cornus nuttallii	0.4 (280)	0.7 (280)	9.0 (280)	0.6 (280)	1.3 (280)	3.1 (280)
Quercus garryana	0.1 (280)	0.1 (280)	9.0 (280)	0.7 (280)	0.9 (280)	1.7 (280)
Calocedrus decurrens	0.0 (280)	0.0 (280)	6.0 (280)	0.6 (280)	0.6 (280)	8.6 (280)

Summary Table of Forest Statistics for the proposed Smoky Creek Research Natural Area. Values given are for all plots sampled, and are means and Coefficient of Variation expressed as a percentage of the mean.

Taxon	Basal Area (m^2/ha)	Rel. Dom.	Density (Stems/ha)	Rel. Dens.	Impt. Val.	$\bar{X}$
Pseudotsuga menziesii	24.4 (130)	52.1 (216)	273.3 (120)	26.5 (105)	53.9 (107)	15.8 (100)
Pinus jeffreyi	11.4 (159)	25.1 (153)	118.1 (190)	25.5 (173)	50.7 (141)	13.0 (163)
Calocedrus decurrens	5.3 (251)	7.4 (215)	63.2 (172)	8.2 (169)	16.7 (162)	7.5 (188)
Pinus lambertiana	6.8 (206)	10.3 (223)	48.5 (158)	15.4 (164)	15.7 (198)	12.6 (169)
Alnus rhombifolia	1.4 (265)	7.7 (298)	14.9 (266)	7.0 (302)	14.7 (298)	4.6 (262)
Pinus ponderosa	9.3 (268)	8.9 (203)	44.3 (215)	5.2 (217)	14.2 (193)	18.3 (158)
Quercus garryana	0.8 (357)	6.3 (383)	12.7 (280)	3.6 (350)	10.0 (371)	2.4 (282)
Quercus chrysolepis	1.0 (276)	1.0 (254)	73.6 (160)	7.4 (162)	8.5 (164)	4.0 (144)
Abies concolor	1.0 (366)	3.1 (380)	27.5 (264)	4.5 (294)	7.7 (325)	2.0 (292)
Quercus kelloggii	0.5 (216)	0.8 (230)	29.2 (166)	3.4 (168)	4.2 (174)	4.0 (161)
Taxus brevifolia	0.1 (392)	0.1 (387)	2.2 (387)	0.5 (387)	0.6 (387)	1.0 (387)
Acer macrophyllum	0.1 (387)	1.0 (387)	2.1 (387)	1.3 (387)	2.3 (387)	2.0 (387)
Cornus nuttallii	0.2 (387)	0.3 (387)	4.2 (387)	0.3 (387)	0.6 (387)	1.4 (387)
Chrysolepis chrysophylla	0.0 (387)	0.0 (387)	2.1 (387)	0.5 (387)	0.5 (387)	0.2 (387)

BASAL AREA PROGRAM
STAND No.-SMKP5
PLOT RADIUS= 15.000 m
PLOT AREA = 706.85 meters²

TAXON	BA (m²/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pseudotsuga menziesii	46.230	63.69	565.88	60.6	124.3	18.5
Pinus ponderosa	14.756	20.33	28.29	3.0	23.3	81.2
Pinus lambertiana	9.751	13.43	28.29	3.0	16.4	58.0
Quercus chrysolepis	1.236	1.70	212.20	22.7	24.4	6.7
Quercus kelloggii	.449	.61	56.58	6.0	6.6	9.4
Calocedrus decurrens	.155	.21	42.44	4.5	4.7	5.3
TOTALS	72.580		933.70			

BASAL AREA PROGRAM
STAND No.-SMKP6
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m²/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pseudotsuga menziesii	69.440	41.92	318.30	38.4	80.3	31.0
Pinus lambertiana	.022	.01	31.83	3.8	3.8	3.0
Pinus ponderosa	95.319	57.54	318.30	38.4	96.0	47.6
Quercus chrysolepis	.387	.23	95.49	11.5	11.7	7.1
Quercus kelloggii	.462	.27	63.66	7.6	7.9	9.6
TOTALS	165.631		827.60			

BASAL AREA PROGRAM
STAND No.-SMKP7
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m²/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus jeffreyi	19.832	78.71	381.97	60.0	138.7	17.2
Calocedrus decurrens	5.361	21.28	254.64	40.0	61.2	15.5
TOTALS	25.194		636.61			

BASAL AREA PROGRAM
STAND No.-SMKP8
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m²/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus jeffreyi	52.764	96.98	222.81	70.0	166.9	54.3
Calocedrus decurrens	1.642	3.01	95.49	30.0	33.0	14.3
TOTALS	54.406		318.30			

BASAL AREA PROGRAM
STAND No.=SMKP13
PLOT RADIUS= 10.000 meters
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	% DB
Pinus jeffreyi	41.740	46.70	732.11	74.1	120.9	20.8
Calocedrus decurrens	47.482	53.13	222.81	22.5	75.7	48.1
Pseudotsuga menziesii	.145	.16	31.83	3.2	3.3	7.6
TOTALS	89.368		986.76			

BASAL AREA PROGRAM
STAND No.=SMKP14
PLOT RADIUS= 10.000 meters
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	% DB
Pseudotsuga menziesii	61.809	93.34	1145.91	85.7	179.0	22.
Cornus nuttallii	3.292	4.97	63.66	4.7	9.7	22.
Quercus chrysolepis	1.117	1.68	127.32	9.5	11.2	10.
TOTALS	66.219		1336.90			

BASAL AREA PROGRAM
STAND No.=SMKP15
PLOT RADIUS= 10.000 meters
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	% DB
Pinus lambertiana	38.078	39.35	159.15	20.0	59.3	50.
Pinus ponderosa	4.939	5.10	31.83	4.0	9.1	44.
Pseudotsuga menziesii	51.693	53.42	254.64	32.0	85.4	36
Quercus chrysolepis	1.509	1.56	286.47	36.0	37.5	7.
Quercus kelloggii	.529	.54	63.66	8.0	8.5	10
TOTALS	96.750		795.77			

BASAL AREA PROGRAM
STAND No.=SMKP1
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Alnus oregana	10.074	31.88	95.49	25.0	56.8	34.6
Taxus brevifolia	.562	1.77	31.83	8.3	10.1	15.0
Pseudotsuga menziesii	6.249	19.77	31.83	8.3	28.1	50.0
Abies concolor	14.674	46.43	190.98	50.0	96.4	24.0
Castinopsis chrysophylla	.039	.12	31.83	8.3	8.4	4.0
TOTALS	31.602		381.97			

BASAL AREA PROGRAM
STAND No.=SMKP2
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pseudotsuga menziesii	94.584	87.13	445.63	36.8	123.9	32.5
Abies concolor	.832	.76	222.81	18.4	19.1	6.4
Quercus chrysolepis	11.624	10.70	350.14	28.9	39.6	18.9
Quercus garryana	.964	.88	63.66	5.2	6.1	12.0
Pinus lambertiana	.542	.49	127.32	10.5	11.0	5.2
TOTALS	108.549		1209.57			

BASAL AREA PROGRAM
STAND No.=SMKP3
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Alnus oregana	12.014	84.22	127.32	80.0	164.2	34.0
Acer macrophyllum	2.249	15.77	31.83	20.0	35.7	30.0
TOTALS	14.264		159.15			

BASAL AREA PROGRAM
STAND No.SMKP4
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters^2

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus jeffreyi	20.862	100.00	63.66	100.0	200.0	64.5
TOTALS	20.862		63.66			

BASAL AREA PROGRAM
STAND No.=SMKP9
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus jeffreyi	36.077	49.99	350.14	28.9	78.9	32.6
Pseudotsuga menziesii	11.061	15.32	541.12	44.7	60.0	8.9
Calocedrus decurrens	25.028	34.68	318.30	26.3	60.9	29.5
TOTALS	72.166		1209.57			

BASAL AREA PROGRAM
STAND No.=SMKP10
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus jeffreyi	.665	5.38	127.32	50.0	55.3	6.5
Quercus garryana	11.691	94.61	127.32	50.0	144.6	25.0
TOTALS	12.356		254.64			

BASAL AREA PROGRAM
STAND No.=SMKP11
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus lambertiana	43.194	83.66	222.81	26.9	110.5	47.2
Pseudotsuga menziesii	2.610	5.05	222.81	26.9	31.9	11.3
Pinus ponderosa	3.204	6.20	222.81	26.9	33.1	11.4
Quercus kelloggii	2.618	5.07	159.15	19.2	24.3	10.5
TOTALS	51.628		827.60			

BASAL AREA PROGRAM
STAND No.=SMKP12
PLOT RADIUS= 10.000 m
PLOT AREA = 314.15 meters²

TAXON	BA (m^2/ha)	REL. DOM.	DENS. (#/ha)	REL. DENS.	IMP. VAL.	X DBH
Pinus ponderosa	30.791	45.27	63.66	7.1	52.4	74.4
Pinus lambertiana	11.575	17.01	159.15	17.8	34.8	25.7
Pseudotsuga menziesii	21.552	31.68	541.12	60.7	92.4	18.9
Quercus chrysolepis	.258	.37	31.83	3.5	3.9	10.1
Quercus kelloggii	3.836	5.64	95.49	10.7	16.3	21.4
TOTALS	68.014		891.26			

Appendix 2.

Typification of the vegetation associations sampled on the proposed Smoky Creek Research Natural Area. The Code of Phytosociological Nomenclature requires that vegetation syntaxa described in the literature for the first time after 1 January 1979 follow the rules setforth therein (cf. Vegetatio Vol. 32:131-185.). Unlatinized names for the various vegetation types can be referenced in Tables 2 & 3.

1. ALLIANCE Peltiphyllo-Alnuetalia rhombifolii All. Nov. Taylor 1979

   Nomenclatural Type: Galio-Alnetum rhombifolii Taylor 1979
   Alliance Diagnostic Taxa: Alnus rhombifolia, Aralia californica, Stachys mexicana, Peltiphyllum peltatum, Carex nudata.

   1. ASSOCIATION Galio-Alnetum rhombifolii Assoc. Nov. Taylor 1979

      Nomenclatural Type: Table 2, Releve SMK 23
      Association Diagnostic Taxa: Scutellaria anthirrnoides, Datisca glomerata, Carex nudata, Aralia californica, Galium triflorum.

   2. ASSOCIATION Prunello-Caricetum bolanderi Assoc. Nov. Taylor 1979

      Nomenclatural Type: Table 2, Releve SMK 15
      Association Diagnostic Taxa: Carex bolanderi, Cirsium arvense, Torreychloa pauciflora, Carex amplifolia

2. ALLIANCE Cirsio-Deschampsietalia All. Nov. Taylor 1979

   Nomenclatural Type: Deschampsio-Caricetum bauxbaumii Taylor 1979
   Alliance Diagnostic Taxa: Carex bauxbaumii, Deschampsia caespitosa, Juncus covillei, Cirsium breweri, Hastingsia alba, Sisyrinchium idahoense.

   3. ASSOCIATION Deschampsio-Caricetum bauxbaumii Assoc. Nov. Taylor 1979

      Nomenclatural Type: Table 2, Releve SMK 18
      Association Diagnostic Taxa: Cirsio-Deschampsietalia taxa, Rhynchospora glomerata var. minor.

3. ALLIANCE Caricon simulato-vesicariae Beguin & Major 1975 em. Taylor 1979

   Nomenclatural Type: Beguin and Major 1975, Table 3, Releve 7 (lectotypus Taylor 1979)
   Alliance Diagnostic Taxa: Carex simulata, C. vesicaria.

   4. ASSOCIATION Caricetum exsiccatae Assoc. Nov. Taylor 1979

      Nomenclatural Type: Table, Releve SMK 1
      Association Diagnostic Taxa: Carex exsiccata.

4. ALLIANCE Onychio-Pinion jeffreyi All. Nov. Taylor 1979

Nomenclatural Type: Haplopappo-Pinetum jeffreyi Taylor 1979
Alliance Diagnostic Taxa: Calamagrostis koelerioides, Onychium densum, Rhamnus californica var, tomentella.

5. ASSOCIATION Haplopappo-Pinetum jeffreyi Assoc. Nov. Taylor 1979

Nomenclatural Type: Table 3, Releve SMKP 8
Association Diagnostic Taxa: Haplopappus ophetidus, Phacelia corymbosa, Cirsium callipes, Senecio greenei, Arenaria rosei, Allium hoffmanii

6. ASSOCIATION Sitanio-Ceanothetum cuneatae Assoc. Nov. Taylor 1979

Nomenclatural Type: Table 3, Releve SMK
Association Diagnostic Taxa: Ceanothus cuneatus, Calamagrostis koelerioides, Polygonum spergulariaefolium.

7. ASSOCIATION Calamagrostio-Pinetum jeffryei Assoc. Nov. Taylor 1979

Nomenclatural Type: Table 3, Releve SMK 16
Association Diagnostic Taxa: Pinus jeffreyi, Calamagrostis koelerioides, Quercus durata, Ceanothus cuneatus.

5. ALLIANCE Pseudotsugion menziesii All. Nov. Taylor 1979

Nomenclatural Type: Pinio-Pseudotsugetum menziesii Taylor 1979
Alliance Diagnostic Taxa: Pseudotsuga menziesii, Pinus ponderosa, Quercus chrysolepis, Pinus lambertiana, Toxicodendron diversilobum.

8. ASSOCIATION Pinio-Pseudotsugetum menziesii Assoc. Nov. Taylor 1979

Nomenclatural Type: Table 3, Releve SMKP 4
Association Diagnostic Taxa: Pinus ponderosa, Pseudotsuga menziesii.

Photo 1. Typical view of open to patchy dense Pseudotsuga menziesii Pinus ponderosa forest on the proposed Smoky Creek RNA.

Photo 2. View of the canopy of Pseudotsuga-Pinus forest, showing the characteristic structure of a mosaic of old-growth and younger successional stage stands.

Photo 3. View of typical Pinus jeffreyi vegetation, with scattered understory shrubs, all on serpentine.

Photo 4. Ceanothus cuneatus vegetation on rocky, serpentine sites with poor soil development.

Photo 5. Seep on serpentine at Silver Spring adjacent to the proposed Smoky RNA. Such vegetation is quite distinctive and of limited distribution in the region.